City, Tex. The western limit of freezing weather for the month is shown by a line traced from northwestern Washington southward, just east of the coast line, to western Oregon, where it touches the coast, and thence southeastward over northern and eastern California to southwestern Arizona.

RANGES OF TEMPERATURE.

The greatest and least daily ranges of temperature at regular stations of the Signal Service are given in the table of miscellaneous meteorological data. The greatest monthly ranges in temperature occurred in the western Dakotas and eastern Montana, where they were more than 70°, whence they decreased eastward to less than 40° on the New England and middle Atlantic coasts, southeastward to less than 30° over extreme southern Florida, southward to less than 40° on the east coast of Texas and less than 50° over the southern plateau region, and westward and southwestward to less than 30° on the north and middle Pacific coasts.

The following are some of the extreme monthly ranges:

Greatest.		Least.	
	°		°
Fort Buford, Dak	89.0	Tatoosh Island, Wash	25.0
Fort Assinniboine, Mont	77.0	Key West, Fla	26.0
Valentine, Nebr	69.0	Point Reyes Light, Cal	27.0
Fort Elliott, Tex	64.0	Phœnix, Ariz	36.0
Columbia, Mo	60.0	San Diego, Cal	37.0

FROST.

On the 29th and 30th frost occurred as far south as northern Florida, and on the 30th was reported in central and western Florida to Lee county. The report of the Alabama state weather service states that the first killing frost of the season occurred in that state on the 29th and 30th, and that its occurrence was about ten days later than the average date of first killing frost. The report of the Mississippi weather service states that all vegetation was killed by the heavy frost on the 29th. In the west Gulf states and Texas frost was reported as far south as Brownsville, Tex., where it was noted on the 17th. Frost was reported on a number of dates in southern New Mexico and southern Arizona. On the Pacific coast frost was reported as far south as Los Angeles, Cal., where it was noted on the 6th, 7th, and 16th to 18th. Compared with October, 1889, the southern limit of frost for the current month has extended nearly five degrees in the Atlantic coast states; about four degrees in Texas; and two to three degrees on the Pacific coast. For November, 1889, frost was reported in the south Atlantic and Gulf states, as follows: It was reported in the greatest number of states, nine, on the 29th; in eight on the 18th, 19th, and 30th; in seven on the 28th; in six on the 4th, 10th, 20th, and 23d; in five on the 3d, 15th to 17th, and 24th; in four on the 9th, and 12th to 14th; in three on the 11th, 22d, and 27th; in two on the 1st, 2d, 6th to 8th, and 21st; and in one on the 5th and 26th—the 25th was the only date on which no frost was reported in one or more of the south Atlantic or Gulf states. On the Pacific coast frost was reported in California on the 1st to 18th, and 23d to 25th; in Oregon on the 4th, 6th, 7th, and 14th to 16th; in Washington on the 1st, 3d to 6th, 13th to 16th, 18th, and 22d to 24th. Frost was reported on the greatest number of dates, twenty-four, in Louisiana; on twenty-one in California; on eighteen in Mississippi; on seventeen in North Carolina and Georgia; on fifteen in Alabama and Texas; on thirteen in Washington; on ten in South Carolina; on nine in Arkansas; on six in Oregon, and on four in Florida.

TEMPERATURE OF WATER.

The following table shows the maximum, minimum, and mean water temperature as observed at the harbors of the several stations; the monthly range of water temperature; and the mean temperature of the air for November, 1889:

Stations.	Temperature at bottom.				Mean temperature of air at the station.
	Max.	Min.	Range.	Monthly mean.	
	°	°	°	°	°
Boston, Mass	51.1	44.3	6.8	48.2	44.6
Canby, Fort, Wash	56.0	48.5	7.5	52.2	50.1
Cedar Keys, Fla	76.3	48.9	27.4	68.1	64.3
Charleston, S. C	67.3	55.0	12.3	63.4	60.0
Eastport, Me	49.4	45.6	3.8	47.8	39.8
Galveston, Tex	74.0	55.5	18.5	62.4	59.6
Key West, Fla	81.5	69.7	11.8	77.6	76.0
Nantucket, Mass	54.0	43.5	10.5	48.9	46.1
New York, N. Y	52.1	45.9	6.2	50.0	46.9
Portland, Oregon	53.5	45.0	8.5	47.9	47.6

PRECIPITATION (expressed in inches and hundredths).

The distribution of precipitation over the United States and Canada for November, 1889, as determined from the reports of nearly 2,000 stations, is exhibited on chart iii. In the table of miscellaneous meteorological data the total precipitation and the departure from the normal are given for each Signal Service station. The figures opposite the names of the geographical districts in the columns for precipitation and departure from the normal show, respectively, the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the precipitation is below the normal and subtracting when above.

The greatest monthly precipitation reported for November, 1889, was 16.25, at Heber, Ark. Monthly precipitation to equal or exceed ten inches was reported in Siskiyou, Shasta, and Placer counties, Cal., east-central Texas, east-central Pennsylvania, northeastern Maryland, northern New Jersey, west-central Connecticut, and extreme southeastern New York. At Hess Road Station, N. Y., a monthly precipitation of 15.23 was reported. On the Pacific coast the monthly precipitation was greatest along the lines of the Southern Pacific Railroad Company in north-central and northeastern California, where it amounted to 11.65 at Dunsmuir, Siskiyou Co., 11.41 at Emigrant Gap, Placer Co., and 10.03 at Delta, Shasta Co., and least in southern and southeastern California, where it was less than one-half inch, and where at Indio, San Diego Co., but 0.01 was reported. In the plateau regions the monthly precipitation was greatest in northern and southeastern Idaho, northeastern Nevada, in areas in central Utah, and in south-central New Mexico, where it exceeded one inch, and where at Nogal, Lincoln Co., N. Mex., it amounted to three inches. In areas in the interior of Nevada, extreme northwestern Utah, and east-central Arizona no precipitation was reported. On the eastern slope of the Rocky Mountains the greatest amount of precipitation fell in central Colorado, where it exceeded four inches, and in extreme northwestern Wyoming, west-central Colorado, west-central Kansas, and north-central and extreme northern Texas, where it exceeded two inches. In Cheyenne county, Nebr., no precipitation was reported. In the central valleys the monthly precipitation was greatest in central Arkansas, where it varied in amount from ten to over sixteen inches, and least in the Dakotas, western Minnesota, and central Mississippi, where less than one-half inch fell, and where at stations in southeastern South Dakota trace was reported. In the Lake region the monthly precipitation exceeded five inches at stations in extreme south-central and southwestern Michigan and western New York, and was less than one inch on the west and northwest shores of Lake Superior. In the Atlantic coast states the monthly precipitation exceeded ten inches in areas in the middle Atlantic states and west-central Connecticut, and was less than one inch in north-central South Carolina, and extreme southwestern Georgia, and was less than one-half inch in central Florida.

The precipitation for November, 1889, was generally above the normal east of the Rocky Mountains, except on the northeastern slope, in the extreme northwest, and the lower Rio Grande valley; it was also above the normal on the middle Pacific coast. In the plateau regions, the upper Missouri valley, the north and south Pacific coasts, and the lower Rio Grande valley the precipitation was generally below the normal amount for the month. The greatest excesses in precipitation were noted in extreme southeastern New York and in central Arkansas, where they were more than six and five inches, respectively. On the North Carolina coast and in northwestern Louisiana the excesses were more than four inches; on the coast of western Maine, from western Connecticut to northeastern Virginia, extreme southern Florida, north-central Tennessee, and east-central Texas more than three inches. The greatest deficiencies in precipitation occurred on the coast of Oregon, where they were more than three inches. On the north coast of Florida and in extreme southern Louisiana the deficiencies were more than two inches. Considered by districts the average percentages of the normal precipitation in districts where the precipitation was in excess of the normal were about as follows: New England, 144 per cent.; middle Atlantic states, 170 per cent.; south Atlantic states, 109 per cent.; Florida Peninsula, 143 per cent.; east Gulf states, 115 per cent.; west Gulf states, 176 per cent.; Ohio Valley and Tennessee, 145 per cent.; lower lake region, 112 per cent.; upper lake region, 107 per cent.; upper Mississippi valley, 113 per cent.; middle-eastern slope of the Rocky Mountains, 160 per cent.; southeastern slope of the Rocky Mountains, 124 per cent.; middle Pacific coast, 111 per cent.

In districts where the precipitation was deficient the percentages of the normal were about as follows: Rio Grande Valley, 69 per cent.; extreme northwest, 66 per cent.; northeastern slope of the Rocky Mountains, 88 per cent.; southern plateau region, 44 per cent.; middle plateau region, 52 per cent.; northern plateau region, 50 per cent.; north Pacific coast, 79 per cent.; southern Pacific coast, 60 per cent. In the Missouri Valley the precipitation averaged normal.

A summary of the precipitation in the several districts from January 1 to November 30, 1889, inclusive, shows that in New England the total average amount for that period was 46.51, or 2.35 more than the average amount. In the middle Atlantic states the amount, 55.86, was 14.50 in excess of the normal. In the south Atlantic states, 52.42, deficiency, 0.18. Florida Peninsula, 47.87, excess, 3.73. East Gulf states, 48.21, deficiency, 6.66. West Gulf states, 43.90, excess, 2.42. Rio Grande Valley, 28.51, deficiency, 0.19. Ohio Valley and Tennessee, 38.10, deficiency, 5.37. Lower lake region, 28.47, deficiency, 4.19. Upper lake region, 27.43, deficiency, 4.69. Extreme northwest, 11.98, deficiency, 6.50. Upper Mississippi valley, 28.47, deficiency, 6.32. Missouri Valley, 23.61, deficiency, 3.58. Northeastern slope of the Rocky Mountains, 12.16, deficiency, 2.73. Middle-eastern slope of the Rocky Mountains, 23.75, excess, 2.12. Southeastern slope of the Rocky Mountains, 23.01, deficiency, 0.81. Southern plateau region, 9.31, deficiency, 2.17. Middle plateau region, 7.42, deficiency, 3.34. Northern plateau region, 11.50, deficiency, 4.17. North Pacific coast, 39.22, deficiency, 10.64. Middle Pacific coast, 22.15, excess, 4.12. South Pacific coast, 13.92, excess 1.56. The more notable features of the precipitation for this period are: the marked excess in the middle Atlantic states, where about one-third more than the usual amount of rain fell, and the deficiencies in the extreme northwest and the middle plateau region, where the total precipitation for the period was but about 66 per cent., in the northern plateau region, where it was about 73 per cent., and on the north Pacific coast, where it was about 80 per cent. of the normal amount for January to November, inclusive.

DEVIATIONS FROM AVERAGE PRECIPITATION.

The following table shows for certain stations, as reported by voluntary observers, (1) the average precipitation for November for a series of years; (2) the length of record during which the observations have been taken and from which the average has been computed; (3) the total precipitation for November, 1889; (4) the departure of the current month from the average; (5) and the extreme monthly precipitation for November during the period of observation and the years of occurrence:

State and station.	County.	(1) Average for the month of Nov.	(2) Length of record.	(3) Total for Nov., 1889.	(4) Departure from average.	(5) Extreme monthly precipitation for November.			
						Greatest.		Least.	
						Am't.	Year.	Am't.	Year.
Arkansas.		*Inches*	*Years*	*Inches*	*Inches.*	*Inches*		*Inches.*	
Lead Hill	Boone	4.08	8	5.10	+1.02	5.77	1883	2.50	1885
California.									
Sacramento	Sacramento	2.02	39	3.49	+1.47	9.65	1885	0.00	'50,'62
Colorado.									
Fort Lyon	Bent	0.28	18	.....	.....	1.50	1883	0.00	1870
Connecticut.									
Middletown	Middlesex	3.91	29	7.03	+3.12	7.29	1877	1.65	1882
Florida.									
Merritt's Island	Brevard	2.43	11	1.16	−1.27	5.67	1884	0.17	1886
Georgia.									
Forsyth	Monroe	3.51	15	5.28	+1.77	5.41	1888	1.01	1887
Illinois.									
Peoria	Peoria	2.32	33	2.91	+0.59	4.93	1879	0.31	1865
Riley	McHenry	2.31	38	2.34	+0.03	8.38	1876	0.08	1862
Indiana.									
Logansport	Cass	3.70	14	.....	.....	5.76	1881	1.43	1880
Vevay	Switzerland	3.19	24	6.06	+2.87	6.34	1888	0.73	1872
Iowa.									
Cresco	Howard	1.48	18	2.22	+0.74	5.20	1879	0.18	1875
Monticello	Jones	2.43	34	0.98	−1.45	5.72	1862	0.12	1865
Logan	Harrison	1.35	19	1.85	+0.50	3.85	1871	0.00	1873
Kansas.									
Lawrence	Douglas	1.90	23	1.96	+0.06	5.15	1879	0.01	1872
Wellington	Sumner	1.00	10	1.70	+0.70	1.98	1881	0.18	1886
Louisiana.									
Grand Coteau	St. Landry	3.41	6	2.85	−0.56	5.72	1883	1.86	1887
Maine.									
Orono	Penobscot	4.70	19	4.50	−0.20	8.76	1886	1.78	1882
Maryland.									
Cumberland	Allegany	2.12	18	5.34	+3.22	5.34	1889	0.82	1887
Massachusetts.									
Amherst	Hampshire	4.68	44	6.55	+1.87	7.48	1854	1.33	1882
Newburyport	Essex	4.18	11	8.15	+3.97	8.15	1889	0.97	1882
Somerset	Bristol	4.55	17	8.91	+4.36	9.02	1876	1.45	1882
Michigan.									
Kalamazoo	Kalamazoo	2.77	13	2.20	−0.57	5.77	1877	1.25	1882
Thornville	Lapeer	2.92	12	3.79	+0.87	4.90	1885	1.42	1882
Minnesota.									
Minneapolis	Hennepin	1.37	23	1.08	−0.29	4.13	1868	0.31	1878
Montana.									
Fort Shaw	Lewis&Clarke	0.45	19	0.10	−0.35	0.89	1880	0.01	1877
New Hampshire.									
Hanover	Grafton	3.77	37	4.76	+0.99	6.62	1885	0.59	1882
New Jersey.									
Moorestown	Burlington	3.32	26	7.02	+3.70	7.02	1889	1.28	1882
South Orange	Essex	3.37	19	11.37	+8.00	11.37	1889	0.95	1883
New York.									
Cooperstown	Otsego	3.06	35	3.50	+0.44	5.38	1858	1.45	1876
Palermo	Oswego	3.65	35	4.11	+0.46	6.60	1866	1.01	1882
North Carolina.									
Lenoir	Caldwell	3.35	17	6.40	+3.05	7.60	1877	0.50	1880
Ohio.									
N. Lewisburgh	Champaign	3.33	14	4.20	+0.87	5.75	1888	0.85	1884
Wauseon	Fulton	3.15	17	3.67	+0.52	5.83	1881	1.46	1884
Oregon.									
Albany	Linn	4.26	10	2.95	−1.31	8.40	1885	1.75	1886
Eola	Polk	4.38	19	3.23	−1.15	13.01	1877	1.45	1886
Pennsylvania.									
Dyberry	Wayne	3.21	18	5.80	+2.59	7.00	1886	1.40	1882
Grampian Hills	Clearfield	3.03	20	3.86	+0.83	6.03	1886	1.42	1872
Wellsborough	Tioga	4.32	10	9.07	+4.75	9.07	1889	2.35	1887
South Carolina.									
Statesburgh	Sumter	1.87	8	2.80	+0.93	3.90	1882	0.87	1886
Tennessee.									
Austin	Wilson	3.82	19	7.13	+3.31	7.24	1874	1.70	1887
Milan	Gibson	4.25	6	8.14	+3.89	8.65	1886	1.61	1884
Texas.									
New Ulm	Austin	5.12	17	3.83	−1.29	14.93	1873	0.48	1887
Vermont.									
Strafford	Orange	3.48	16	5.50	+2.02	6.20	1888	0.50	1874
Virginia.									
Birdsnest	Northampton	2.98	20	5.05	+2.07	5.80	1885	0.40	1879
Wisconsin.									
Madison	Dane	2.06	20	1.17	−0.89	4.92	1856	0.53	1870
Washington.									
Fort Townsend	Jefferson	2.88	14	1.55	−1.33	9.21	1874	0.39	1884

The above table shows that at Cumberland, Md., eighteen years record, the precipitation for the current month, 5.34, was the greatest ever reported at that place for November, the greatest previous November precipitation, 5.10, being noted in 1877. At Newburyport, Mass., eleven years record, the greatest November precipitation noted for preceding years, 6.74, in 1888, was 1.41 less than the amount reported for the current month; at Moorestown, N. J., twenty-six years

record, the amount for November, 1889, 7.02, was 0.72 greater than the greatest amount reported for the corresponding month of preceding years, noted in 1877; at South Orange, N. J., nineteen years record, the previous maximum precipitation for November, 6.62, in 1877, was 4.75 less than the precipitation reported for the current month; and at Wellsborough, Pa., ten years record, the precipitation for November, 1889, exceeded the greatest amount previously reported for November, 7.71, in 1886, by 1.36.

Table of excessive precipitation, November, 1889.

State and station.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Alabama.	*Inches.*	*Inches.*		*Inches*	*h. m.*	
Bermuda		3.00	1			
Evergreen		2.56	21			
Mount Vernon Barracks		3.63	2			
Alaska.						
Juneau		3.10	14			
Arkansas.						
Conway	13.17					
Heber	16.25					
Little Rock	10.20	3.15	7			
Do		3.47	12-13			
Little Rock Barracks	11.26	3.31	7			
Malvern	12.34	2.60	12			
Monticello		2.91	12			
Newport (1)	10.17					
Newport (2)	13.30	3.30	7			
Russellville	11.25					
California.						
American Hill		2.90	20			
Crescent City		2.96	21			
Delta	10.03					
Dunsmuir	11.65					
Emigrant Gap	11.41					
Grass Valley		2.54	19			
Iowa Hill		2.72	20			
Sims	13.32					
Connecticut.						
Hartford (1)		3.40	27-28			
New Hartford (1)		3.30	27-28			
New Haven		2.62	27-28			
Shelton	10.03	4.85	27			
Wallingford		3.66	28			
Florida.						
Fort Barrancas		2.65	2			
Jupiter				1.00	1 00	17
Key West		4.52	9			
Pensacola		3.55	2			
Georgia.						
Columbus		2.50	17			
Illinois.						
Cairo		2.96	7-8			
Indiana.						
Huntingburgh		2.55	7			
Marengo		2.70	7			
Princeton		2.50	26			
Kansas.						
Brookville		2.50	7-8			
Mankato		3.50	1			
Kentucky.						
Springfield		2.50	13			
Louisiana.						
Columbia		3.00	7			
Do		3.00	12			
Coushatta (1)		3.05	7			
Coushatta (2)		2.90	6			
Shreveport		2.57	6-7			
Maine.						
Fort Preble		4.30	27-28			
Kent's Hill		2.50	21-22			
Portland		3.40	27-28			
Maryland.						
Galena	10.17					
Massachusetts.						
Amherst		3.18	27-28			
Amherst Experimental Station (1)		3.12	27-28			
Fall River		2.75	27-28			
Fitchburg		2.58	28			
Leicester		3.09	27-28			
Newburyport		4.10	28			
Northampton		2.95	28			
Somerset		3.17	27-28			
Springfield Armory		2.65	27-28			
Westborough		3.25	27-28			
Worcester (1)		2.53	27-28			
Missouri.						
Hermann		3.20	1			
New Hampshire.						
Nashua		2.63	28			
New Jersey.						
Atlantic City		2.94	27-28			
Belleville	11.45	3.99	27			
Egg Harbor City		2.50	27-28			
Gillette	10.19					
Hanover	10.72					
Madison	10.20	2.91	9			
Newark		2.84	27			
New Brunswick		2.54	27-28			

Table of excessive precipitation—Continued.

State and station.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
New Jersey—Continued.	*Inches.*	*Inches.*		*Inches*	*h. m.*	
Oceanic		3.21	27			
Plainfield	11.13	3.40	8-9			
South Orange	11.37	3.50	10			
Do		2.68	27			
Union	10.56	3.17	8-9			
New York.						
Ardenia		3.75	27-28			
Boyd's Corners		3.69	27-28			
Central Park, N. Y. City	10.03	3.65	9			
David's Island		3.12	27-28			
Fort Columbus		2.71	9			
Do		3.16	27-28			
Fort Hamilton		2.50	9-10			
Fort Schuyler		3.50	9			
Do		3.33	27			
Fort Wadsworth		2.71	27-28			
Hess Road Station	15.23	2.75	19			
Madison Barracks	10.02					
New York City		2.50	9			
Do		2.88	27-28			
Setauket		3.00	9			
West Point		3.20	27-28			
White Plains	11.66	5.04	27-28			
Willet's Point	10.28	3.54	27-28			
Do		3.60	8-9			
North Carolina.						
Lenoir		3.00	16-17			
Mount Pleasant		3.05	16-17			
Pennsylvania.						
Blooming Grove		2.60	27-28			
Doylestown	10.05					
Girardville	10.16					
Lancaster		2.66	18-19			
Lock Haven		2.51	18-19			
Myerstown		2.73	18-19			
Nisbet		2.90	19			
Quakertown		2.59	9			
Selin's Grove		3.56	18-19			
Wellsborough		3.96	19			
West Chester		2.62	19			
Smith's Corner		2.78	9			
Westtown		2.90	19			
South Carolina.						
Charleston		5.84	16-17			
Clinton		2.50	16			
Jacksonborough		3.05	17			
Port Royal		3.15	16			
Spartanburgh (1)		2.70	16-17			
Winnsborough		2.75	17			
Yorkville		2.51	17			
Tennessee.						
Knoxville		3.07	8			
Trenton		2.83	18			
Texas.						
Brady		2.50	2			
Brazoria		3.52	6			
Columbia		2.85	5			
Corsicana (2)		3.65	7			
Tyler	10.49					
Vermont.						
Brattleborough (1)		2.93	28			
West Virginia.						
Weston		2.82	14			

Excessive precipitation data received too late for publication in October, 1889, Review.

California.						
Arcata		2.89	7			
Dunsmuir	20.15					
Tehama	11.15					

EXCESSIVE PRECIPITATION.

For November, 1889, monthly precipitation to equal, or exceed, ten inches was reported at eight stations in Arkansas; at seven stations in New Jersey; at five stations in New York; at four stations in California; at three stations in Alabama; at two stations in Pennsylvania; and at one station in Connecticut, Maryland, and Texas. The greatest monthly precipitation reported was 16.25, at Heber, Ark.; elsewhere the precipitation for the month was less than fifteen inches, except at Hess Road Station, N. Y., where 15.23 inches were reported.

In November of preceding years precipitation to equal, or exceed, ten inches has been reported most frequently in Oregon, where it was noted for twenty-one years. In Washington this amount has been equalled, or exceeded, in November for twenty years; in California for eleven years; in

Alabama, Massachusetts, Mississippi, and New York for from five to ten years, inclusive; and in Arkansas, Delaware, Florida, Georgia, Indiana, Kentucky, Louisiana, Maine, Maryland, Michigan, Missouri, New Hampshire, New Jersey, North Carolina, Texas, Virginia, and Wisconsin from one to four years, inclusive. In states and territories other than those named precipitation to equal, or exceed, ten inches in November has not been reported for preceding years. Among the heavier rainfalls reported for November of preceding years are: 31.93, at Crescent City, Cal., in 1885; 20.51, at Downieville, Cal., in 1859; 22.40, at Meadow Valley, Cal., in 1865; 24.12, at Georgetown, Cal., in 1875; 24.75, in 1865, and 24.54, in 1885, at Fort Gaston, Cal.; 29.38, at Delta, Cal., in 1885; 20.89, at Point Pleasant, La., in 1877; 22.21, at Fort Stevens, Oregon, in 1877; 27.60, at Neah Bay, Wash., in 1865; 20.70, at Tatoosh Island, Wash., in 1869. Exclusive of the instances and years cited, precipitation to equal, or exceed, fifteen inches has been reported for November for eight years in Washington; for seven years in Oregon; for four years in California; for two years in New Hampshire; and for one year, each, in Florida, Louisiana, and Maine.

Precipitation to equal, or exceed, 2.50 inches in twenty-four hours in November, 1889, was reported at fourteen stations in New York, on the 8th, 9th, 19th, 27th, and 28th; at eleven stations in Massachusetts, on the 27th and 28th; at eleven stations in Pennsylvania, on the 9th, 18th, 19th, 27th, and 28th; at ten stations in New Jersey, on the 8th to 10th, 27th, and 28th; at seven stations in South Carolina, on the 16th and 17th; at five stations in Arkansas, on the 7th, 12th, and 13th; at five stations in Connecticut, on the 27th and 28th; at four stations in California, from the 19th to 21st; at four stations in Louisiana, on the 6th, 7th, and 12th; at four stations in Texas, on the 2d, and 5th to 7th; at three stations in Alabama, on the 1st, 2d, and 21st; at three stations in Florida, on the 2d and 9th; at three stations in Indiana, on the 7th and 26th; at three stations in Maine, on the 21st, 22d, 27th, and 28th; at two stations in Kansas, on the 1st, 7th, and 8th; at two stations in North Carolina, on the 16th and 17th; at two stations in Tennessee, on the 8th and 18th; at one station in Georgia, on the 17th; at one station in Illinois, on the 7–8th; at one station in Kentucky, on the 13th; at one station in Missouri, on the 1st; at one station in New Hampshire and Vermont, respectively, on the 28th; and at one station in West Virginia, on the 14th. Among the heavier rainfalls reported for this period were: 4.85, at Shelton, Conn., on the 27th; 4.52, at Key West, Fla., on the 9th; 4.10, at Newburyport, Mass., on the 28th; 5.84, at Charleston, S. C., on the 16–17th; 5.04, at White Plains, N. Y., on the 27–28th; and 4.30, at Fort Preble, Me., on the 27–28th.

Precipitation to equal, or exceed, 2.50 inches in twenty-four hours in November of preceding years has been most frequently reported in Louisiana and Texas, where it has been noted for fifteen years. In North Carolina this amount in the period given has been equalled, or exceeded, for thirteen years; in Alabama, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Massachusetts, Mississippi, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee, and Washington, for from five ten years, inclusive; and in Arkansas, Arizona, California, Colorado, Delaware, District of Columbia, Indian Territory, Kentucky, Maine, Maryland, Michigan, New Hampshire, New Mexico, Rhode Island, South Carolina, Vermont, Virginia, and Wisconsin, from one to four years, inclusive. In states and territories other than those named precipitation to equal, or exceed, 2.50 inches in twenty-four hours has not been reported for November of preceding years. Among the heavier rainfalls reported for this period for November of preceding years are: 7.00, at Marion, Miss., 6–7th, 1885; 10.04, San Luis Obispo, Cal., 17–18th, 1885; 10.39, Fort Barrancas, Fla., 26th, 1878; 7.10, Point Pleasant, La., 20th, 1877; 7.00, Belmont Farm and Melissa, Tex., 1877. Exclusive of the instances and years cited, precipitation to equal, or exceed, five inches in the period given has been reported in Texas for two years, and in Florida, Illinois, Louisiana, North Carolina, and Pennsylvania for one year.

The only report of precipitation to equal, or exceed, one inch an hour was 1.00 in one hour, at Jupiter, Fla., on the 17th. At Corpus Christi, Tex., 0.60 fell in twenty minutes on the 26th.

In November of preceding years precipitation to equal, or exceed, one inch in one hour has been reported for six years in Texas; for three years in North Carolina and Tennessee; for two years in California, Indiana, Mississippi, and New York; and for one year in Alabama, District of Columbia, Florida, Georgia, Kansas, Kentucky, Michigan, Nebraska, Pennsylvania, and Virginia. In states and territories other than those named precipitation to equal, or exceed, one inch in one hour in November has not been reported for preceding years. Among the heavier November rainfalls for one hour, or less, reported for preceding years are: 0.25, in two minutes, at New York, N. Y., 18th, 1886; 1.48, in fifteen minutes, at Galveston, Tex., 5th, 1877; 1.82, in twenty minutes, at Vicksburg, Miss., 15th, 1879; 3.50, in thirty minutes, at Galveston, Tex., 2d, 1873.

MAXIMUM RAINFALLS IN ONE HOUR OR LESS.

The following table is a record of the heaviest rainfalls during November, 1889, for periods of five and ten minutes and one hour, as reported by regular stations of the Signal Service furnished with self-registering gauges:

Station.	Maximum fall in—					
	5 min.	Date.	10 min.	Date.	1 hour.	Date.
	Inch.		*Inch.*		*Inch.*	
Bismarck, N. Dak*						
Boston, Mass	0.05	19	0.10	19	0.32	28
Buffalo, N. Y†	0.03	2	0.05	2	0.20	2, 19, 27
Cincinnati, Ohio	0.04	8	0.08	8	0.30	8
Detroit, Mich†	0.03	2	0.05	2	0.15	2
Galveston, Tex	0.05	16	0.06	16	0.16	16
Jupiter, Fla	0.24	17	0.40	17	1.00	19
New York, N. Y	0.08	27	0.15	9, 27	0.47	27
New Orleans, La‡	0.05	13	0.08	13	0.20	13, 16
Norfolk, Va	0.10	21	0.20	21	0.40	21
Savannah, Ga	0.08	3	0.15	3	0.50	16
San Francisco, Cal	0.07	18	0.14	18	0.32	18
Saint Louis, Mo	0.10	26	0.12	26	0.20	26
Washington, D.C.	0.10	13	0.20	13	0.47	13

*No record on account of snow. †Record incomplete on account of snow. ‡Record not complete.

SNOW (snowfall in inches and tenths).

A remarkable feature for November was the heavy snow storm which prevailed in eastern Colorado, western Kansas, northeastern New Mexico, and extreme northern Texas during the early portion of the current month. This storm was most severe during the 4th, 5th, and 6th, when snow, attended by low temperature and high wind, caused loss of life and considerable damage to live stock. The snowfall was variously reported from one to two feet deep in northeastern New Mexico and adjacent parts of Colorado and Texas, and the drifts were sufficiently deep to seriously interfere with railroad traffic.

This storm attended the presence over the plateau and Rocky Mountain regions of an area of high pressure described as number i under the heading "Atmospheric pressure."

Mr. M. A. Upson, voluntary observer at Roswell, N. Mex., submits the following interesting report in connection with this storm:

The snow storm and blizzard along the line of the Pan Handle of Texas and the eastern line of New Mexico on the 4th, 5th, and 6th of November, 1889, although giving the heaviest fall of snow ever known this far south in the valley of the Rio Pecos, was comparatively light at this place, and there was but one portion of the day, on the 7th, that was excessively cold, the temperature falling to 12°. The weight of the storm in New Mexico fell on Colfax and Mora counties, in the extreme northeast of the territory, though it was more severe across the line in Texas. Crossing the Rio Pecos, east, the first bench of the plains, some fifty miles, like our valley, is protected by mountains on the north and west, and by the San Juan Range. As you reach the second bench the ascent is rapid until you reach an extensive flat "mesa" (table) where commences the Staked Plains (Llano Estacado). This "mesa" is literally unprotected from north, east, and northeast winds for hundreds of miles. Blasts from the north and east gather force, and, by the time they reach the thirty-seventh parallel of latitude, they are often

charged with frost, sleet, hail, and snow, killing to men and stock. In the storm of November the cow boys lost their lives at a point over two hundred miles from this place. Stock drifted before the storm and hundreds were driven in on to the Pecos. However, this year they were in good condition and the loss was not as heavy as was anticipated. Stock is always fat on the plains, and stock belonging on the river, which had strayed to the plains, fared the worst. As I said before, although severe, the severity and results of this storm have been very much exaggerated in public reports. The men who lost their lives were brave; they were holding beef cattle for shipment only a few miles from settlements when the herds commenced to drift, and it would have been easy to leave them to their fate and seek their own safety; but faithful to their employers, they tried to hold the stock together, and stayed with them until all trails were obliterated; blinding snow, driven with all the velocity of a Texas "norther," obscured air, earth, and sky, and, experienced plainsmen as they were, they were as helpless as babes. The courage and devotion of cow boys in the interests of their employers is little appreciated in the East. Hundreds of them have died at their posts within my twenty-six years experience in New Mexico.

The greatest depth of snowfall reported for the month was sixty-one inches, at Summit, Cal. At Breckenridge, Colo., forty-seven inches were reported; at Cisco, Cal., twenty-eight inches; at Roswell, N. Mex., twenty-nine inches; at Green Bay, Wis., twenty-two inches; at Blue Knob, Pa., twenty-two inches; and at Alpena, Mich., twenty-one inches. The snowfall for the month exceeded fifteen inches in east-central Arizona, northwestern Iowa, east-central Minnesota, extreme northern New York, northeastern Ohio, northeastern Oregon, and extreme northern Texas, and was more than ten inches in northeastern Illinois, central Kansas, western Montana, north-central Nebraska, northern New Hampshire, extreme south-central South Dakota, northeastern Vermont, and northwestern Wyoming. Snow in measurable quantities fell north of a line traced from extreme southern New Jersey, southwestward to northern Georgia, thence westward to central Arkansas, thence southwestward to central Texas, thence westward south of El Paso, Tex., thence irregularly northwestward to western Oregon, and east of this line continued northeastward to northeastern Washington.

Snowfalls of five inches or more were reported as follows, and in states and territories where the maximum depth was below that amount, the station reporting the greatest is given: *Alabama.*—Valley Head, trace. *Arizona.*—Cooley Springs, 16; Flagstaff and Holbrook, 5. *Arkansas.*—Lead Hill, 4. *California.*—Summit, 61; Cisco, 28; Truckee, 10.8; Boca, 9. *Colorado.*—Breckenridge, 47; Gunnison, 36; Leadville, 30; Emma, 28.5; Apishapa, 27.5; Frazer, 26.5; Ranch, near Como, 26.3; Fort Lewis, 21; Durango, 19; Georgetown, 18; Glenwood Springs, 17.5; Eagle Farm, 14; Magnolia, 13; Monte Vista, 12.5; San Luis Experimental Station, 11.5; Pueblo, 10.1; Cañon City and Rocky Ford, 10; Fort Logan, 9; Wigwam, 8.2; Byers and Brush, 7.8; Palmer Lake, 7.2; Idaho Spring, 7; Agate, 6; Denver, 5.8; Fort Collins, 5.6. *Connecticut.*—Mansfield, trace. *District of Columbia.*—Trace. *Georgia.*—Diamond, 2.5. *Idaho.*—Soda Springs, 9.5; Era, 9; Kootenai, 8. *Illinois.*—Watseka, 11.0; Greenville, 10.2; Jordan's Grove, 8.3; Centralia and Windsor, 8; Aurora, 7.8; Hilton, 7.2; McLeansborough, 6.5; Mascoutah, 6; Gibson City, Golconda, Rushville, and Woodstock, 5.5; Pontiac, 5. *Indiana.*—Angola, 6.6; Columbia City and Huntington, 6. *Indian Territory.*—Fort Reno, trace. *Iowa.*—Sac City, 15; Sioux City, 12; Wesley, 11; Logan, 10; Larrabee and Storm Lake, 8; Manson, 7; Cresco, 5.5. *Kansas.*—Gorham, 10; Concordia, Gove City, and Oakley, 6; Conway and Tribune, 5.4; Lakin, 5. *Kentucky.*—Shelbyville, 6.5; Lexington, 5.5; *Maine.*—Kent's Hill, 8; Cornish, Fairfield, Farmington, Lewiston, and West Jonesport, 7; Orono, 6; Mayfield, 5. *Massachusetts.*—North Billerica, 1. *Michigan.*—Buchanan, 23; Harrisville, 22.5; Alpena, 21.3; Gladwin, 18.8; Cauldwell, 18; Albion, 17; Vandalia, 16.5; Lathrop, 16; Bangor, 15.3; Hastings, 14.7; Cassopolis, Fort Mackinac, Port Huron, and Crawford, 14; Weldon Creek, 13.5; Traverse City, 13.2; Berrien Springs, Parksville, Stanton, and West Branch, 13; Marshall, 12.7; Arbela, 12.5; Benton Harbor, Ivan, North Aurelius, Ovid, Paw Paw, and Saint John, 12; Fitchburgh and Mottville, 11; Lansing *b*, 10.8; Concord, 10.6; Alma, Berlin, Deer Lake, Eden, and Grayling, 10.5; Allegan, Ball Mountain, Birmingham, Chase, Evart, Grand Rapids, Gulliver Lake, Thornville, and Vienna, 10; Fremont, 9.8; Lansing *a* and Olivet, 9.5; Adamsville, Clinton, Colon, and Washington, 9; Bear Lake, Big Rapids, Highland Station, Kalamazoo, Manistee, Mio, Roscommon, Stockbridge, and Traverse City *b*, 8; Bronson, 7.5; Hayes, Hudson, Jeddo, and Pontiac, 7; Calumet, 6.8; Fort Brady and Sault de Sainte Marie, 6.4; Bell Branch, 6; Manchester, Marquette, and Ypsilanti, 5.5; Ann Arbor, Atlantic, and Hillsdale, 5. *Minnesota.*—Pokegama Falls, 16.8; Rolling Green, 16; Farmington, 13; Lake Winnibigoshish, 12.2; Owatonna, 10.5; Leech Lake, 10.4; Red Wing, 10.2; Mankato, 9.7; Saint Charles, 9.5; Saint Vincent, 9; Minneapolis, 8.6; Duluth, 8.4; Le Seur, 7.8; Northfield, 7.7; Grand Meadow, 7.5; Pine River, 6; Osseo, 5.5. *Mississippi.*—Corinth and Holly Springs, 2. *Missouri.*—Saint Charles, 8; Ironton, 6. *Montana.*—Virginia City, 11.8; Fort Missoula and Helena, 11; Fort Maginnis, 9.2; Glendive, 6. *Nebraska.*—De Soto, 13.8; Kennedy, 12; Marquette, 10.5; Craig, 9.8; Fort Assinniboine, 7.3; Genoa, 7; Fort Niobrara, 6. *Nevada.*—Toano, 10.2. *New Hampshire.*—Berlin Mills, 14; West Milan, 8; Hanover *a* and North Conway, 7; Hanover *b*, 6; North Chesterfield, 5. *New Jersey.*—Oceanic, 0.5. *New Mexico.*—Nogal, 30; Roswell, 29; Las Vegas, 23; Chama, 16; Gallinas Spring, 13; Hillsborough, 12; Fort Stanton, 10; Deming and Fort Wingate, 5. *New York.*—Turin, 15.8; Constableville, 14; Canton, 13.7; North Hammond, 12; Plattsburgh Barracks, 11.1; Oswego, 10.2; Palermo, 10; Humphrey and Potsdam, 9.5; Buffalo, 8; Utica, 7; Number Four and Queensbury, 6; Saranac Lake, 5.8; Rochester, 5.7; Angelica, 5.5; Eden, 5. *North Carolina.*—Hot Springs, 2. *North Dakota.*—Fort Buford *a*, 5.6; Fort Buford *b*, 5.4. *Ohio.*—Bement, 15; Jefferson, 14.4; Wauseon, 9.5; Kent, 9; Cleveland, 8.3; Carrollton, 7; Napoleon, 6; Elyria and Kenton, 5.2. *Oregon.*—Joseph, 16; Baker City, 10; Telocaset, 9; Siskiyou, 8; North Powder, 6.5; The Dalles, 5. *Pennsylvania.*—Blue Knob, 21.9; Edinbororough, 6. *South Carolina.*—Simpsonville, trace. *South Dakota.*—Fort Randall, 11; Canton, 10.8; Fort Meade, 7. *Tennessee.*—Rugby and Trenton, 5. *Texas.*—Hartley, 16; Panhandle, 9; Epworth, 8; Fort Elliott, 7.2; Ochiltree, 6; El Paso, 5.4. *Utah.*—Mount Pleasant, 6. *Vermont.*—Chelsea and Weathersfield Centre, 10; Hartland, 8; East Berkshire, 7.5; Northfield and Strafford, 6; Saxton's River, 5. *Virginia.*—Bolar, 1.5. *Washington.*—Spokane Falls, 2.1. *West Virginia.*—Buckhannon, 6; Tannery, 5.5. *Wisconsin.*—Green Bay, 22.3; Summit Lake, 13; Embarrass, 9.8; Butternut, 9; Grantsburgh, 6.9; Waucousta, 6.5. *Wyoming.*—Camp Sheridan, 12.3; Saratoga, 10; Fort Bridger, 12.3; Sundance, 8.6; Camp Pilot Butte, 8; Fort Washakie, 7.1; Lusk, 7; Cheyenne, 6; Carbon and Carter, 5.

DEPTH OF SNOW ON GROUND AT CLOSE OF MONTH.

Chart iv shows the depth of snow reported on the ground at the close of the month. Snow was generally reported on the ground on the last day of the month in New England north of Massachusetts, with a depth of from four to six inches in the interior of Maine and the more northern parts of New Hampshire and Vermont. In New York twelve inches were reported near the eastern extremity of Lake Ontario. In Pennsylvania, seven inches at Blue Knob. In the upper lake region, fifteen inches at Alpena, Mich., and more than ten inches in extreme southwestern Michigan. In Minnesota, nine inches at Pokegama Falls. East of the Mississippi River the line of appreciable snowfall extended southward into Tennessee. In Colorado twenty inches were reported at Breckenridge; elsewhere west of the one hundredth meridian no snow was reported on the ground at the close of the month, except along the northern border of the United States, in extreme western Nebraska, central Colorado, southwestern Montana, and in Idaho.

HAIL.

Hail was reported during the month as follows: 2d, N. Y.

4th, Ariz. 5th, Ariz., Tex. 7th, Kans. 9th, Pa. 10th, Mass. 12th, Tenn., Wash. 13th, Utah. 16th, Ala., N. J., S. C., Tenn. 17th, Ill., N. C., Ohio, Tenn. 18th, Cal. 19th, N. C., Oregon, Wash. 20th, N. Y., Oregon, Wash. 21st, Va., Wash. 22d, Cal., Utah, Va. 23d, N. Y., Wash. 25th, Kans. 26th, Ill., Md., Mo., Ohio. 27th, Mass., N. Y., Pa. 28th, Iowa, Kans., Me., N. Y., Vt. 29th, Mass., R. I.

SLEET.

Sleet was reported as follows: 1st, Wis. 2d, Nebr., N. Dak. 4th, Ariz., Ind. T., N. Y. 5th, Tex., Vt. 7th, Ind., Kans., Tenn., W. Va. 10th, Idaho, Me., N. H. 12th, Tex., Wis. 14th, Pa. 15th, Ohio, Pa., Tex. 16th, Ind., Ky., N. Y., N. C., S. C., Tenn. 17th, Ala., Ill., Ind., N. Y., Ohio, Tenn., Va., W. Va. 18th, Pa., Tenn., W. Va. 19th, Ga., Mont. 20th, Tex. 21st, N. Y. 22d, Utah. 23d, Conn., Wis. 25th, Conn., Kans., Utah. 26th, Ill., Ind., Kans., Mo., Ohio, Pa. 27th, Ill., Ind., Mass., N. H., N. Y., Pa., Tenn., Wis. 28th, Colo., Ga., Ill., Me., N. H., N. Y., Tenn., Vt. 30th, Wis.

WINDS.

The prevailing winds during November, 1889, are shown on chart ii by arrows flying with the wind. In New England, the middle Atlantic, south Atlantic, and east Gulf states, in the Ohio Valley and Tennessee, and the lower lake region, on the northeastern slope of the Rocky Mountains, and in the middle plateau region, the prevailing winds were westerly; in Florida, northerly; in the west Gulf states, the upper lake region, the extreme northwest, the upper Mississippi and Missouri valleys, and on the southeastern slope of the Rocky Mountains, north to northwest; over the northern plateau region, southeast to southwest; on the north Pacific coast, south to east; on the south Pacific coast, north to east; and in the Rio Grande Valley, on the middle-eastern slope of the Rocky Mountains, over the southern plateau region, and on the middle Pacific coast, variable.

HIGH WINDS (in miles per hour).

Maximum velocities of fifty miles, or more, per hour were reported at regular stations of the Signal Service as follows: Fort Canby, Wash., 88, s., 17th; 68, s., 25th; Wood's Holl, Mass., 63, se., 28th; Eastport, Me., 60, e., 28th; Block Island, R. I., 60, e., 28th; Winnemucca, Nev., 58, s., 22d; New London, Conn., 54, se., 28th; Galveston, Tex., 54, nw., 26th; Fort Elliott, Tex., 54, n., 20th; 50, n., 11th; Buffalo, N. Y., 52, sw., 3d; Fort McKinney, Wyo., 50, w., 22d.

LOCAL STORMS.

No severe thunder-storms were reported during the month.

Press reports state that a destructive storm moving from the southwest passed over New Berne, N. C., at 1 p. m. on the 21st, causing loss of life and considerable damage to property, and that on the 28th a destructive storm passed over the northern part of Beaufort Co., N. C., cutting a swath half a mile wide through timber, prostrating buildings, and causing considerable loss of life. During the 27th and 28th severe gales prevailed over the Lake region, New York, and New England. C. L. Bozzell, observer, Signal Corps, Sault de Sainte Marie, Mich., reports that high northeasterly winds, accompanied by fine, blinding snow, prevailed during the 27th and 28th, with maximum wind velocity thirty miles per hour on the 28th; that the storm was unusually severe on the lakes, and that a number of vessels were wrecked. W. H. Andy, observer, Signal Corps, Marquette, Mich., reports that the wind increased to twenty-six miles per hour at 2.45 p. m., 26th, and was accompanied by light and heavy snow until the morning of the 28th; that the light-house was washed from its moorings, and considerable damage was done to the breakwater. H. L. Boyce, observer, Signal Corps, Port Huron, Mich., reports that a severe and almost continuous gale prevailed from the 26th to 30th, and that owing to the heavy snow it was the most dangerous experienced in that locality for years; maximum wind velocity thirty-four miles per hour at 8.05 a. m., 27th. T. F. Schley, observer, Signal Corps, Green Bay, Wis., reports that the wind reached a velocity of sixty miles per hour from the north on the 27th; that the gale was accompanied by snow, and that many disasters were reported on the lakes. S. W. Rhode, observer, Signal Corps, Milwaukee, Wis., reports that the northeast gale of the 27th and the northwest gale of the 28th, with maximum velocity thirty-seven and forty-two miles per hour, respectively, were quite severe, and caused very high seas on Lake Michigan; that a large number of vessels, with valuable cargoes, were ashore near "the straits;" that several serious disasters occurred off Chicago, and that none of the regular line steamers left the port of Milwaukee during those dates. H. C. Frankenfield, observer, Signal Corps, Chicago, Ill., reports that a severe gale prevailed throughout the day of the 28th, reaching a maximum velocity of thirty-seven miles per hour, and that numerous vessels were disabled on Lake Michigan. Dr. E. U. Jones, voluntary observer, Taunton, Mass., reports that a terrific gale prevailed at that place during the night of the 27–28th. Paul Daniels, observer, Signal Corps, New London, Conn., reports that a severe wind storm prevailed from the evening of the 27th to the morning of the 28th, with a maximum velocity of fifty-four miles per hour at 3.10 a. m., 28th, and that the tide was unusually high in the harbor during the day of the 28th. The snow storms of the month are referred to under the heading "Snow," in the chapter on "Precipitation."

INLAND NAVIGATION.

ICE IN RIVERS AND HARBORS.

The following notes relative to ice in rivers and harbors have been made by observers of the Signal Service:

Mississippi River.—La Crosse, Wis.: floating ice in river 18th to 20th, 24th, 25th, 27th, 29th, and 30th. The steam ferry boat "Warsaw" stopped running on the 29th, owing to ice. Saint Paul, Minn.: floating ice in river 16th, 17th, 24th, and 25th. The river was entirely gorged with ice on the 30th. Keokuk, Iowa: ice began running in the river on the 28th, and the steamer "Patience" laid up on that date, closing navigation for the season. Dubuque, Iowa: the river was full of floating ice on the 28th, and froze over on the 29th.

Missouri River.—Fort Buford, N. Dak.: floating ice in river 12th to 14th. The river froze over on the 15th, and remained closed until the end of the month. Fort Yates, N. Dak.: the river was closed to navigation by ice on the 25th. Yankton, S. Dak.: the river froze over on the 27th, and navigation is closed for the season.

Red River of the North.—Saint Vincent, Minn.: the ferry boat laid up for the season on the 22d, on account of ice.

FLOODS.

Press reports state that the rivers at Johnstown, Pa., reached the danger-point and overflowed their banks on the 9th, causing considerable damage to railroad and other property. From the 17th to the 21st damaging floods and washouts, resulting from heavy rains, occurred at various points in Pennsylvania, New Jersey, and southern New York. The severe rain storm of the 27th and 28th resulted in serious washouts on railroads,